SOLUTIONS

PROGRESS TEST-2

RB-1806 & RBS-1802

JEE MAIN PATTERN

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PHYSICS

1. (D)

Given $(\vec{a}+3\vec{b}).(7\vec{a}-5\vec{b}) = 0 \Rightarrow 7a^2 - 15b^2 + 16\,\vec{a}.\vec{b} = 0$ ...... (1)

Also, $(\vec{a}-4\vec{b}).(7\vec{a}-2\vec{b}) = 0 \Rightarrow 7a^2 + 8b^2 - 30\,\vec{a}.\vec{b} = 0$ ...... (2)

Subtracting, $-23b^2 + 46\,\vec{a}.\vec{b} = 0 \Rightarrow \vec{a}.\vec{b} = \frac{b^2}{2}$

Putting this in (1),

$7a^2 - 7b^2 = 0 \Rightarrow |\vec{a}| = |\vec{b}|$. Thus $\vec{a}.\vec{b} = ab\cos\theta$

$\Rightarrow \frac{b^2}{2} = b^2\cos\theta \Rightarrow \cos\theta = \frac{1}{2}$ or $\theta = 60°$.

2. (A)

3. (B)

4. (D)

$A = 3N$, $B = 2N$ then

$R = \sqrt{A^2 + B^2 + 2AB\cos\theta}$

$R = \sqrt{9 + 4 + 12\cos\theta}$ ...(i)

Now $A = 6N$, $B = 2N$ then

$2R = \sqrt{36 + 4 + 24\cos\theta}$ ...(ii)

from (i) and (ii) we get $\cos\theta = -\frac{1}{2}$ $\therefore$ $\theta = 120°$

5. (B)

6. (C)

Kx = mg

$x = \frac{mg}{K} = \frac{0.1\times10}{20} = \frac{1}{20}$ = 5 cm,

Apply $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$

7. (C)

8. (D)

$$\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$$

$$-\frac{dv}{v^2}+\left(\frac{-du}{u^2}\right)=0$$

$$dv=-\left(\frac{v}{u}\right)^2 du$$

$$=-(2)^2\times 1mm$$

$=-4mm \Rightarrow$ length of image = 4 mm

9. (B)

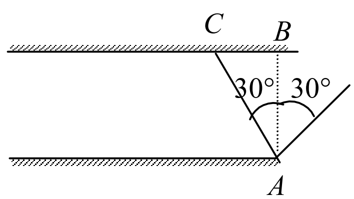
As $\vec{A}\cdot\vec{B}=0$

$(3i-5j+5k)\cdot(5i-j-4k)=15+5-20=0$

hence angle between $\vec{A}$ and $\vec{B}$ is 90°

10. (B)

From the law of refection



tan30° = $\frac{BC}{AB}=\frac{BC}{0.2}$; $BC=0.2\times\frac{1}{\sqrt{3}}=0.115$

Total no. of reflection = 30

11. (C) **12. (D)** **13. (D)** **14. (B)**

15. (B) **16. (C)** **17. (C)**

18. (C)

For equilibrium of $\sqrt{2}$ M block

$2T\cos\theta=\sqrt{2}Mg$, $T = Mg$, $\cos\theta=\frac{1}{\sqrt{2}}$, $\theta = 45°$

19. (A)

$R = mg + F_2 \cos\theta$

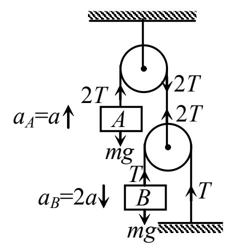
Also, $f = F_1 + F_2 \sin\theta \le \mu R = \mu[mg + F_2 \cos\theta]$

$$\Rightarrow \mu \ge \frac{F_1 + F_2 \sin\theta}{mg + F_2 \cos\theta} \Rightarrow \mu_{min} = \frac{F_1 + F_2 \sin\theta}{mg + F_2 \cos\theta}$$

20. (D)

$2T - mg = ma$ ...(i)

$mg - T = 2ma$ ...(ii)



(i) and (ii) $\Rightarrow$ $a = \frac{g}{5}$

$\therefore$ $a_B = \frac{2g}{5}$

21. (C)

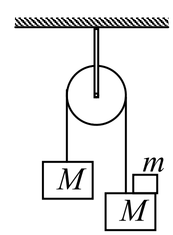
From constraint relation $v_B = \frac{v}{3}$

22. (D)

$T = 0$, $a = g$

23. (B)

Acceleration of blocks = $\frac{(M+m)g - Mg}{2M+m} = \frac{mg}{2M+m}$



Considering free body diagram of block *m* only

$mg - N = ma$

$N = m(g-a) = m\left[g - \frac{mg}{2M+m}\right]$

$N = \frac{2mMg}{2M+m}$

24. (B)

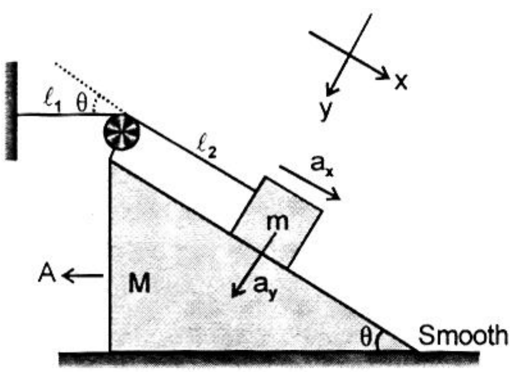
$$\hat{n} = \frac{\vec{A}\times\vec{B}}{|\vec{A}\times\vec{B}|}$$

$$\vec{A}\times\vec{B} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 1 & 1 & 0 \\ 0 & 1 & -1 \end{vmatrix} = \hat{i}(-1-0)-\hat{j}(-1-0)+\hat{k}(1-0) = -\hat{i}+\hat{j}+\hat{k}$$

$|\vec{A}\times\vec{B}| = \sqrt{3}$, $\hat{n} = \frac{1}{\sqrt{3}}(-\hat{i}+\hat{j}+\hat{k})$

25. (A)

Constraint relation :

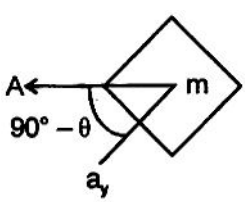


$L = \ell_1 + \ell_2$

$\frac{dL}{dt} = \frac{d\ell_1}{dt} + \frac{d\ell_2}{dt}$ (String constrains)

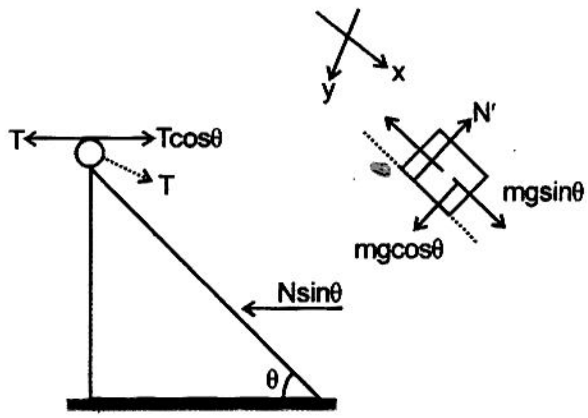
$0 = (-A) + (A\cos\theta + a_x)$

$a_x = A(1-\cos\theta)$



$a_y = A\cos(90° - \theta)$ – (Wedge constraints)

and $a_y = A\sin\theta$



Equations of motion

Considering the motion of wedge in horizontal direction.

For wedge :

$T - T\cos\theta + N\sin\theta = MA$ ....(i)

Considering the motion of block parallel and perpendicular to the sloping side in horizontal direction.

For block : In the direction parallel to inclined surface.

$mg\sin\theta - T = ma_x = MA(1-\cos\theta)$

or $T = mg\sin\theta - MA\,(1-\cos\theta)$ ....(ii)

In the direction perpendicular to inclined plane,

$mg\cos\theta - N = ma_y = mA\,\sin\theta$

$N = mg\cos\theta - mA\sin\theta$ ....(iii)

Substituting the value of N from (ii) and (iii) in (i), we get

$$A = \frac{mg\sin\theta}{M + 2m(1-\cos\theta)}$$

26. (C) **27. (B)** **28. (A)** **29. (C)**

30. (C)

In the case of minimum deviation, ray inside the prism is parallel to base.

Therefore, ray is deviated equally from both refracting faces

If, $\delta = 34°$, $\delta' = \frac{\delta}{2} = 17°$

CHEMISTRY

31. (C)

$MCl_x + x\,AgNO_3 \rightarrow x\,AgCl + M(NO_3)_x$

Moles of $AgNO_3$ required for precipitation $= 500 \times 0.8 \times 10^{-3}$

Now 0.1 mol of MCl_x requires $AgNO_3$ = 0.4 mol

1 mol of MCl_x requires $AgNO_3$ = 4 mol

$\therefore$ x = 4

32. (C)

$$\underset{0.5\,g}{CaCO_3} \longrightarrow \underset{\substack{112\,ml \\ at\,NTP}}{CO_2} + \underset{0.28\,g}{CaO}$$

112 ml of CO_2 has a mass = $\frac{44}{22400} \times 112 = 0.22$ g

or $0.5\,g = 0.22\text{ g} + 0.28\text{ g}$

Hence law of conservation of mass holds.

33. (A)

0.5% Se is present in peroxidase anhydrous enzyme so for the presence of 78.4 gm Se, the amount of enzyme should be

$$\frac{100}{0.5} \times 78.4 = 156.8 \times 10^2 \text{ gm} \quad \text{or} \quad 1.568 \times 10^4 \text{ gm}$$

34. (A)

Volume of cylindrical virus

$= \pi r^2 \ell$

$= 3.14 \times (7 \times 10^{-8})^2 \times (10 \times 10^{-8})$

$= 3.14 \times 49 \times 10^{-16} \times 10^{-7}$

$= 153.86 \times 10^{-23}$ cc

Weight of one virus particle

$= \frac{\text{Volume}}{\text{Specific volume}}$

$= \frac{153.86 \times 10^{-23}}{6.02 \times 10^{-2}}$ gm

Molecular weight of virus

$$= \frac{153.86 \times 10^{-21}}{6.02} \times 6.02 \times 10^{23}$$

= 15.4 kg/mol.

35. (D)

$$M_f = \frac{200 \times 4 \times 2 + 300 \times 3}{500} = 5\ M$$

36. (C)

$$\underset{114\,g}{C_8H_{18(\ell)}} + \underset{25/2\,mol}{\frac{25}{2}O_2} \longrightarrow 8CO_2 + 9H_2O$$

Mass of 1.425 L of petrol = $1.425 \times 10^3 \times 0.8$

= 1140 g

1140 g of petrol consume $O_2 = \frac{25 \times 10}{2}$ mol = 125 mol.

37. (A)

$$3BaCl_2 + 2Na_3\,PO_4 \rightarrow Ba_3\,(OP_4)_2 + 6NaCl$$

Limiting reagent is 0.2 mol sodium phosphate.

38. (A)

342g of $C_{12}H_{22}O_{11}$ gives C = 144 g

$\therefore$ 34.2 g of $C_{12}H_{22}O_{11}$ gives C = 14.4 g

39. (B)

$CaCl_2.6H_2O$; Mass = 40 + 71 + 108 = 219

On rendering anhydrous, percentage of mass lost

$$\frac{108 \times 100}{219} = 49.3\%$$

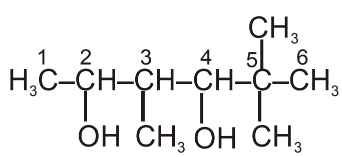
40. (A)

Number of moles Cd^{2+} = $500 \times 10^{-3} \times 0.2$ = 0.1 mol

Now, 0.1 mol of Cd^{2+} require H_2S

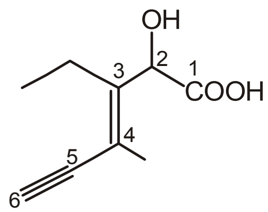
= 0.1 mol or 0.1 × 34 = 3.4 g.

41. (A)

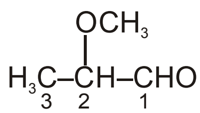


3,5,5-Trimethylhexane-2,4-diol

42. (C)

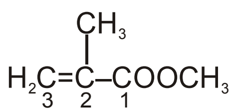


43. (C)



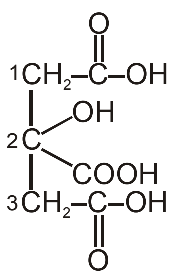
2-Methoxypropanal

44. (D)



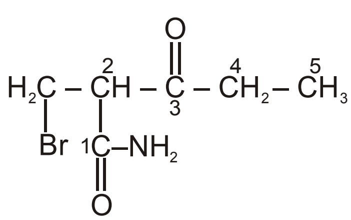
Methyl-1,2-methylprop-2-enoate

45. (B)



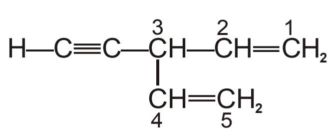
2-Hydroxypropane-1,2,3-tricarboxylic acid

46. (D)

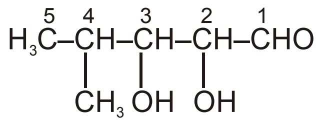


2-(Bromomethyl)-3-oxopentanamide

47. (B)



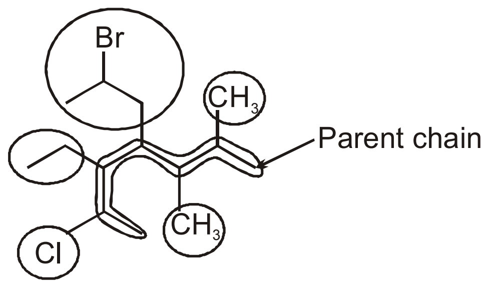
48. (A)



2,3-Dihydroxy-4-methylpentanal

49. (B)

50. (C)



5-Substituents

51. (B)

x – c = ?

dx – x = 1.0 Å

dc – c = 1.54 Å

En of x = 3.00

En of c = 2.00

dA – B = $r_A + r_B - 0.09\,(x_A - x_B)$

where x_A = En of A

x_B = En of B

dx – c = 0.50Å + 0.77Å – 0.09 (3 – 2.00) = 1.18Å

52. (A)

2nd ionisation potential of Li, O N & F.

After loss of one electron Li^+ got Noble gas electronic configuration and more stable.

53. (B)

Maximum jump in $I.P._4$ = 170,6eV No of valence electrons = 3.

54. (B)

$19K^+ = 1.34\,\text{Å}$ (Cationic radius)

$9^F = 1.34\,\text{Å}$ (Anionic radius)

in neutral condition size of K and F has $2.03\,\text{Å}$ and $0.72\,\text{Å}$ respectively.

55. (D)

$2s^1$ $2s^2$ $2p^1$ $2p^2$ $2p^3$ $2p^4$ $2p^5$ $2p^6$
Li, Be, B, C, N, O, F , Ne

IP of half filled electronic configuration is greater than adjacent atom.

IP_1 = Li < B < Be < C < O< N < F < Ne

56. (A)

Both fluorine and neon are 2nd period element. Fluorine is smallest size while neon has vander wall forces.

57. (B)

Electronic configuration $4f^{1-14}\,5d^{0-1}\,6s^2$ belongs to 'f' blcok- III B Group.

58. (B)

Along the period ΔHeg increases. Due to half filled atomic orbital N has less ΔHeg than O.

59. (B), factual

60. (A)

$\Delta H_{ion.} = -\Delta Heg$

MATHEMATICS

61. (D)

Here $R = \{(x,y) : |x^2 - y^2| < 16\}$ and given $A = \{1,2,3,4,5\}$

$\therefore R = \{(1,1);(1,2)(1,3)(1,4);(2,1)(2,2)(2,3)\ (2,4);(3,1)(3,2)\ (3,3)(3,4);(4,1)(4,2)(4,3);$

$(4,4)(4,5),(5,4)(5,5)\}$

62. (D)

Given, $xRy \Rightarrow x$ is relatively prime to y.

$\therefore$ Domain of $R = \{2,3,4,5\}$.

63. (C)

R be a relation on N defined by $x + 2y = 8$.

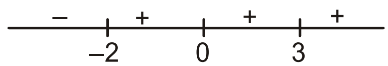
$R = \{(2,3);(4,2);(6,1)\}$

Hence, Domain of $R = \{2,4,6\}$.

64. (A)

It is obvious.

65. **(C)**



66. **(A)**

$$\cos\frac{\pi}{19}+\cos\frac{3\pi}{19}+\cos\frac{5\pi}{19}+\ldots+\cos\frac{17\pi}{19}$$

Use formula

if $\cos\alpha+\cos(\alpha+\beta)+\ldots+\cos(\alpha+(n-1)\beta)=\dfrac{\cos(\alpha+(n-1)\beta/2)\sin\left(\beta\dfrac{n}{2}\right)}{\sin\left(\dfrac{\beta}{2}\right)}$

where $\alpha=\dfrac{\pi}{19}$, $\beta=\dfrac{2\pi}{9}$, n = 9

67. **(B)**

$$\alpha=\beta=\gamma=\frac{\pi}{2}$$

68. **(B)**

We have,

$\cos\theta\cos2\theta\cos2^2\theta\ \ldots\ \cos2^{n-1}\theta = \dfrac{\sin2^n\theta}{2^n\sin\theta} = \dfrac{\sin(\pi-\theta)}{2^n\sin\theta}$ [$\because 2^n\theta=\pi-\theta$]

$= \dfrac{1}{2^n}$

69. **(C)**

$7x - 1 = 12$, $7x - 1 = -12$

70. **(B)**

5 lies in 4th quadrant

71. **(C)**

We have $2^{x+2} > 2^{-2/x}$. Since the base 2 > 1, we have $x + 2 > -2/x$ (the sign of the inequality is retained). Solving the last inequality, we obtain $x \in (0, \infty)$

72. (A)

$$(a\cdot\frac{1-\tan^2\theta}{1+\tan^2\theta}+b\cdot\frac{2\tan\theta}{1+\tan^2\theta}) = a$$

73. (B)

$$\log_{49}28=\frac{\log 28}{\log 49}=\frac{\log 7+\log 4}{2\log 7}$$

$$=\frac{\log 7}{2\log 7}+\frac{\log 4}{2\log 7}=\frac{1}{2}+\frac{1}{2}\log_7 4$$

$$=\frac{1}{2}+\frac{1}{2}.2\log_7 2=\frac{1}{2}+\log_7 2=\frac{1}{2}+m=\frac{1+2m}{2}$$

74. (A)

$$\log_e\left(\frac{a+b}{2}\right)=\frac{1}{2}(\log_e a+\log_e b)$$

$$=\frac{1}{2}\log_e(ab)=\log_e\sqrt{ab}$$

$$\Rightarrow\frac{a+b}{2}=\sqrt{ab}\Rightarrow a+b=2\sqrt{ab}$$

$$\Rightarrow\left(\sqrt{a}-\sqrt{b}\right)^2=0\Rightarrow\sqrt{a}-\sqrt{b}=0\Rightarrow a=b.$$

75. (D)

If $\log_4 2+\log_4 4+\log_4 16+\log_4 x=6$

then $\log_4(2\times 4\times 16\times x)=6$

$$\Rightarrow\log_4 128x=6\Rightarrow 128x=4^6$$

$$\Rightarrow x=\frac{64\times 64}{128}\Rightarrow x=32$$

76. (D)

$\cos 90^0=0$

77. (A)

$x^2=16\Rightarrow x=\pm 4$

$2x=6\Rightarrow x=3$

There is no value of x which satisfies both the above equation. Thus, $A=\phi$.

78. (C)

$n(A^c \cap B^c) = n[(A \cup B)^c] = n(U) - n(A \cup B)$

$= n(U) - [n(A) + n(B) - n(A \cap B)]$

$= 700 - [200 + 300 - 100] = 300.$

79. (B)

$x^2 - 5x + 7 < 1 \quad ; \qquad x^2 - 5x + 6 < 0$

$(x - 2)\ (x - 3) < 0$

80. (B)

$$\begin{cases} 0 \le \alpha \le \dfrac{\pi}{2} \\ 0 \le \beta \le \dfrac{\pi}{2} \end{cases} \Rightarrow \begin{cases} 0 \le \alpha + \beta \le \pi \\ -\dfrac{\pi}{2} \le \alpha - \beta \le \dfrac{\pi}{2} \end{cases}$$

$$\cos(\alpha + \beta) = -\frac{4}{5} \;\Rightarrow\; \frac{\pi}{2} \le \alpha + \beta \le \pi \quad \Rightarrow\; \tan(\alpha + \beta) = -\frac{3}{4}$$

$$\sin(\alpha - \beta) = \frac{5}{13} \;\Rightarrow\; 0 \le \alpha - \beta \le \frac{\pi}{2} \quad \Rightarrow\; \tan(\alpha - \beta) = \frac{5}{12}$$

$$\therefore \quad \tan 2\beta = \tan((\alpha + \beta) - (\alpha - \beta)) = \frac{-\frac{3}{4} - \frac{5}{12}}{1 - \frac{15}{48}} = -\frac{56}{33}$$

81. (D)

$2\cos(A + B)\cos(A - B) + \cos 2C = -2\sin C\cos(A - B) + 1 - 2\sin^2 C$

$= 1 - 2\sin C\,(\cos(A - B) + \sin C)$

$= 1 - 2\sin C\,(\cos(A - B) - \cos(A + B))$

$= 1 - 4\sin A\sin B\sin C$

82. (D)

We have, $\tan\theta = \dfrac{1}{2}$

$$\therefore \quad \tan 2\theta = \frac{2\tan\theta}{1 - \tan^2\theta} = \frac{4}{3}$$

Now, $$\tan(2\theta + \phi) = \frac{\tan 2\theta + \tan\phi}{1 - \tan 2\theta\tan\phi} = \frac{\frac{4}{3} + \frac{1}{3}}{1 - \frac{4}{3} \times \frac{1}{3}} = 3$$

83. (B)

$-\sqrt{49+25} \le 2k+1 \le \sqrt{49+25}$

84. (C)

$\sin(2n\pi+\theta)=\sin\theta$, there are total 10 terms.

85. (D)

Use $\frac{x^2-5x+6}{x^2+x+1}>0 \Rightarrow x \in (-\infty,2)\cup(3,\infty)$ and $[x^2-1]>0 \Rightarrow x\in(-\infty,-\sqrt{2}]\cup[\sqrt{2},\infty]$

86. (C)

$2^{2\log_2(2x)}=36\,;\,4x^2=36\,;\; x=\pm 3$

87. (C)

We have,

$5^{\log_a x}+5x^{\log_a 5}=3 \Rightarrow x^{\log_a 5}+5x^{\log_a 5}=3$ $\quad[\because x^{\log_a y}=y^{\log_a x}]$

$\Rightarrow 6\cdot x^{\log_a 5}=3 \Rightarrow x^{\log_a 5}=\frac{1}{2}$

$\Rightarrow x=(2^{-1})^{\log_5 a}=2^{-\log_5 a}$

88. (A)

$\sin\theta=\operatorname{cosec}\theta=1$

89. (C)

According to property $|f(x)|=-f(x)$, then $f(x)\le 0$

$|x-1|\,|x-2|=-(x-2)(x-1)\Rightarrow(x-1)(x-2)\le 0\Rightarrow 1\le x\le 2$

90. (C)

(1) If $x^2+4x+2\ge 0$, then the equation is equivalent to the system $\begin{cases} x^2+4x+2\ge 0 \text{ and} \\ 3x^2+7x-10=0, \end{cases}$

solving which we find x = 1.

(2) If $x^2+4x+2<0$, then the equation is equivalent to the system $\begin{cases} x^2+4x+2<0 \text{ and} \\ 3x^2+17x+22=0, \end{cases}$

solving which we find x = –2.